SEED STORAGE

Seed storage is an essential part of a system which requires a regular and sustained seed supply for planting programmes. Seed moisture and temperature are two primary factors for maintaining viability of seed in storage. Amongst these, moisture is more important than temperature (3,5). The seed moisture content of 5 to 10 percent and storage temperature of 0° to 5°C has been generally found to be suitable for different tree seeds (4).

Such facilities of seed storage are presently available only in the Pakistan Forest Institute, Peshawar. In view of the continuous and increasing demand for quality seeds of different tree species from various government and private organizations, such facilities are needed in all provinces and regions of Pakistan.

REFERENCES


4. Bonner, F.T. Storage principles for tropical tree seeds. USDA Forest Service. Southern Experiment Station, Starkville, USA.


SUITABLE SPACING FOR PLANTING OF POPLAR IN AGROFORESTRY SYSTEMS

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ABSTRACT

In view of popularity of the Poplar tree with the farmers, it was desired to work out a suitable pattern of planting Poplar (Populus deltoides) in AF system for intercropping with agricultural crops. A replicated experiment involving agricultural crops (maize and wheat) and silvicultural crop. (Poplar) was initiated during 1990-91 at PFRI Research Garden. Poplar was planted in rows 6.1 m, 9.2 m, and 12.2 m apart with a uniform distance of 1.5 m from tree to tree within the rows. Maize and wheat was intercropped with the Poplar crop. The result available up to September, 1993 has shown that pattern of planting in rows 9.2 m or 12.2 m apart is a good system to allow intercropping up to 5th or even 6th year age of...
Data regarding yield of agricultural crops and growth of Poplar was collected regularly.

RESULTS AND DISCUSSION

Maize Fodder

The data regarding maize fodder is given in table-1.

Table 1. Yield of maize fodder intercropped with Poplar.

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Treatments (Poplar spacing)</th>
<th>Yield in Kg/ha</th>
<th>Gross returns (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1.5x6.1 m</td>
<td>23654</td>
<td>13504</td>
</tr>
<tr>
<td>2.</td>
<td>1.5x9.2 m</td>
<td>23654</td>
<td>14934</td>
</tr>
<tr>
<td>3.</td>
<td>1.5x12.2 m</td>
<td>27220</td>
<td>13669</td>
</tr>
</tbody>
</table>

The above yield figures show that during first two years various Poplar spacings did not have any effect on the yield of maize fodder. However, during 3rd year the effect of various Poplar spacings on the yield of maize fodder is apparent. At this stage the distance between the crowns of trees between two lines was on an average 0.9 m, 3.05 m, and 6.1 m in case of treatment No.1, 2, and 3 respectively. The position of crowns in the field also indicated that intercropping could be continued for at least another two years in case of 2nd treatment and another three years in case of 3rd treatment, i.e. upto 5th or 6th year age of the Poplar.

Wheat Crop

Two wheat crops were raised and data regarding grain and straw-yield was collected. The grain yield data is given in Table 2.

Table 2. Yield of wheat grain intercropped with Poplar.

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Treatments (Poplar spacing)</th>
<th>Grain yield in Kg/ha</th>
<th>Gross returns (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1.5m x 6.1m</td>
<td>2683</td>
<td>2356</td>
</tr>
<tr>
<td>2.</td>
<td>1.5m x 9.2m</td>
<td>2177</td>
<td>2384</td>
</tr>
<tr>
<td>3.</td>
<td>1.5m x 12.2m</td>
<td>2695</td>
<td>2302</td>
</tr>
</tbody>
</table>

* From sale of wheat ‘bhoosa’ for 2 years
The figures of wheat yield indicate that different spacings of Poplar have not affected the grain yield of wheat. Similar results regarding wheat yield are expected during spring 1994. This is mainly because of the fact that Poplar trees are leafless during the period when wheat is intercropped with it. In view of these results and the position of crowns, it is expected that wheat crop could be grown with Poplar up to 4th, 5th, and 6th year of the Poplar age under treatments 1st, 2nd, and 3rd respectively.

**Poplar Crops**

The growth data of Poplar collected by yearly interval is given in table-3.

Table 3. Poplar Growth under different spacings.

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Treatments (P.spacing)</th>
<th>GROWTH DATA</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Height (m)</td>
<td>Dia. (cm)</td>
<td>Height (m)</td>
<td>Dia. (cm)</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>1.5mx6.1m</td>
<td>6.3</td>
<td>8.8</td>
<td>11.3</td>
<td>11.8</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>1.5mx9.2m</td>
<td>7.5</td>
<td>7.5</td>
<td>12.0</td>
<td>12.9</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>1.5mx12.2m</td>
<td>7.9</td>
<td>8.3</td>
<td>10.2</td>
<td>13.1</td>
<td></td>
</tr>
</tbody>
</table>

Different spacings do not appear to be having any effect on the growth of Poplar trees so far.

Width of crown and clear bole length measured during the last week of September, 1993 is given in table-4.

Table 4. Crown width and clear bole length.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Treatments (P.spacing)</th>
<th>Crown width (m)</th>
<th>Clear bole length (m)</th>
<th>Spacing between crowns within two rows (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1.5mx6.1m</td>
<td>5.2</td>
<td>2.5</td>
<td>0.91</td>
</tr>
<tr>
<td>2.</td>
<td>1.5mx9.2m</td>
<td>6.0</td>
<td>2.5</td>
<td>3.05</td>
</tr>
<tr>
<td>3.</td>
<td>1.5mx12.2m</td>
<td>5.9</td>
<td>2.3</td>
<td>6.10</td>
</tr>
</tbody>
</table>

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Poplar crop. The experiment is in progress.

INTRODUCTION

*Poplar* (*Populus deltoides*) is an important commercial tree of the Punjab and it is frequently grown in the agricultural fields. Recently, the agroforestry system of growing Poplar with agricultural crops on the farmlands has become very popular among the farmers. In order to standardize the pattern and spacing of planting Poplar with agricultural crops an experiment was designed and initiated during 1990-91 at PFRI Research Garden.

Sheikh et al. (1984) determined the effect of poplar shade on the yield of wheat at Changa Manga and reported that even the close distance of 0.75 and 2.75 meter from poplar trees had no significant effect. It was indicated that 4 years old poplars planted at 5.5 x 5.5 m did not depress grain or straw yield within the rows and the practice could be safely adopted by the farmers in the country. Li (1985) reported an increase and decrease in wheat (and the yield of trees themselves) recorded from the windward and sheltered side of a belt of *Populus nigra* var. **italica.** Overall results showed 17% increase in agri. crops by the shelterbelt. Sheikh and Khalique (1982) conducted a study to find out the effect of tree rows of *Eucalyptus camaldulensis* on the yield of agricultural crops and indicated that when the trees were 5-6 m in height and wheat was sown, the yield was not depressed. However, in case of cotton, when the height of tree belts was upto 7 m, the yield was comparatively less within a distance of 15-30 m on either side of the belt.

Sheikh and Cheema (1976) surveyed wheat fields having single tree rows on different sides of their boundary for determination of the effect of trees on the yield of wheat grain and observed a beneficial effect. This effect varied with distance from the tree rows in individual fields while among different fields the magnitude of this effect changed with orientation of tree rows. It is indicated that an overall improvement in the yield of wheat can be brought about if properly oriented windbreaks are planted. Vasilev (1980) reported that shelterbelts increased the grain yield by 0.7-0.8 t/ha by improving the soil structure and reduction in physical evaporation by 5-6%. He also concluded that combination of shelterbelts with "flat" tillage (i.e. discing) gave higher yields than cultivation by mould board ploughing. Dense shelterbelts due to shade reduced grain yields by 0.24 - 0.26 t/ha and proved effective with any type of cultivation.

METHODS AND PROCEDURE

An experiment with spacing of 1.5x6.1 m, 1.5x9.2 m, 1.5x12.2 m for Poplar was designed in 1990 and laid out during February, 1991 in the Research Garden, PFRI Faisalabad. The distance between Poplar rows was kept 6.1 m, 9.2 m, and 12.2 m, whereas distance from plant to plant within the rows was 1.5 m in all the treatments. Randomised Complete Block Design was used and the experiment was replicated three times. Experimental unit was a plot of 43.6x27.7 m, i.e. 0.12 hectare. The number of tree rows per plot were 4, 5 and 7 in plots having line to line distance of 12.2 m, 9.2 m, and 6.1 m respectively.

Poplar plants from 2nd stage nursery were planted at the prescribed spacing during February, 1991. Maize crop was raised for fodder during "kharif" 1991. It was followed by wheat crop during "rabi" season. The same rotation was followed throughout, and upto September 1993 three crops of maize fodder and two crops of wheat have been obtained.
Table 5. Number, Volume and Weight of Poplar Trees under various treatments.

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Treatments (P.spacing)</th>
<th>No of trees per ha</th>
<th>Av.Dia (cm)</th>
<th>Av.Ht (m)</th>
<th>Av.Vol (m³)</th>
<th>Vol/hc (m³)</th>
<th>Av.wt/m³ (kg)</th>
<th>Wt/tree (kg)</th>
<th>Weight per ha (kg)</th>
<th>Sale rate (40 kg)</th>
<th>Income per ha (Rs)</th>
<th>Income per ha @ Rs.80 per tree (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.5mx6.1m</td>
<td>1074</td>
<td>11.7</td>
<td>11.3</td>
<td>0.068</td>
<td>46.93</td>
<td>720</td>
<td>42.80</td>
<td>46005</td>
<td>80</td>
<td>90240</td>
<td>92006</td>
</tr>
<tr>
<td>2</td>
<td>1.5mx9.2m</td>
<td>716</td>
<td>12.9</td>
<td>11.9</td>
<td>0.067</td>
<td>47.97</td>
<td>720</td>
<td>46.96</td>
<td>35063</td>
<td>80</td>
<td>68792</td>
<td>70168</td>
</tr>
<tr>
<td>3</td>
<td>1.5mx12.2m</td>
<td>536</td>
<td>13.2</td>
<td>10.1</td>
<td>0.067</td>
<td>35.91</td>
<td>720</td>
<td>48.96</td>
<td>26251</td>
<td>80</td>
<td>51695</td>
<td>52504</td>
</tr>
</tbody>
</table>

Data regarding volume and weight of Poplar trees under various spacings is given in Table 5.

Expenditure per hectare

The yearly expenditure incurred on the experimental plots per hectare is given in table-

Table 6. Expenditure incurred on the experimental plots.

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Treatments (P.spacing)</th>
<th>Yearly expenditure/ha</th>
<th>Total expenditure/ha (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1990</td>
<td>1991</td>
</tr>
<tr>
<td>1</td>
<td>1.5mx6.1m</td>
<td>2278</td>
<td>8517</td>
</tr>
<tr>
<td>2</td>
<td>1.5mx9.2m</td>
<td>2278</td>
<td>6992</td>
</tr>
<tr>
<td>3</td>
<td>1.5mx12.2m</td>
<td>2278</td>
<td>6753</td>
</tr>
</tbody>
</table>

Gross Income

Gross income from the agricultural crops obtained during the experimental period and the expected total value of Poplar trees during September, 1993 is given in table-7. Values compounded at the rate of 10%.
Table 7. Gross income from agricultural crops and Poplar trees per hectare.

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Treatments (P.spacing)</th>
<th>Maize fodder (Rs.)</th>
<th>Wheat crop (Rs.)</th>
<th>Value of Poplar trees (Rs.)</th>
<th>Total gross income (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1.5mx6.1m</td>
<td>10902</td>
<td>22515</td>
<td>85990</td>
<td>119407</td>
</tr>
<tr>
<td>2.</td>
<td>1.5mx9.2m</td>
<td>14665</td>
<td>19671</td>
<td>57327</td>
<td>91663</td>
</tr>
<tr>
<td>3.</td>
<td>1.5mx12.2m</td>
<td>16152</td>
<td>21463</td>
<td>42896</td>
<td>80511</td>
</tr>
</tbody>
</table>

Net Income

Net income per hectare from this agroforestry system at the age of three years of Poplar is given in table-8. Values compounded at the rate of 10%.

Table 8. Net income per hectare under various treatments.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Treatments (P.spacing)</th>
<th>Gross income (Rs.)</th>
<th>Expenditure (Rs.)</th>
<th>Net income (Rs.)</th>
<th>Net income per year (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1.5mx6.1m</td>
<td>119407</td>
<td>17596</td>
<td>101811</td>
<td>33937</td>
</tr>
<tr>
<td>2.</td>
<td>1.5mx9.2m</td>
<td>91663</td>
<td>16071</td>
<td>75592</td>
<td>25197</td>
</tr>
<tr>
<td>3.</td>
<td>1.5mx12.2m</td>
<td>80511</td>
<td>15831</td>
<td>64680</td>
<td>21560</td>
</tr>
</tbody>
</table>

Net income per year has been derived by dividing the total net income by 3, i.e. the age of Poplar trees.

Table 9. Net income from agricultural component per hectare.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Treatments (P.spacing)</th>
<th>Expenditure (Rs.)</th>
<th>Gross returns (Rs.)</th>
<th>Net income (Rs.)</th>
<th>Net income per year (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1.5mx6.1m</td>
<td>13019</td>
<td>33417</td>
<td>20398</td>
<td>6799</td>
</tr>
<tr>
<td>2.</td>
<td>1.5mx9.2m</td>
<td>13019</td>
<td>34337</td>
<td>21318</td>
<td>7106</td>
</tr>
<tr>
<td>3.</td>
<td>1.5mx12.2m</td>
<td>13019</td>
<td>37616</td>
<td>24597</td>
<td>8199</td>
</tr>
</tbody>
</table>

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Net income per year has been calculated by dividing the total net income by 3, i.e., the number of years during which 5 agricultural crops have been raised and sold. Only variable costs have been considered.

CONCLUSIONS

The agroforestry system of intercropping wheat and millet with Poplar trees planted in the pattern of widely spaced rows having trees at close spacing within the rows is a good model for practice by the farmers in the irrigated areas. In case off rows 9.2 m and 12.2 m apart, cultivation of agricultural crops is possible up to 5th or even 6th year age of the Poplar. If Poplar is to be grown at 8 years rotation, the Poplar trees can be allowed to grow for 2 years more and then harvested and sold for industrial purpose.

Net income from only agricultural crops (Table-9) is minimum (Rs.6799/-) with high density of Poplar (1.5mx6.1m) and increases with decrease in density. Whereas over-all net income (Table-8) is maximum (Rs.33937/-) with high density of Poplar (1.5mx6.1m) and decreases with decreasing density.

The distance between the rows and plant to plant distance within the rows will be guided further by the priority of tree crop or agricultural component. If the agricultural component is more important, the number of trees per hectare can be reduced whereas if tree component is more important, the number of trees per hectare can be increases.

If tree component is more valuable, then 1.5mx9.2m or even 1.5mx6.1m spacing pattern should be adopted. If agricultural component is expected to bring higher income, then 1.5mx12.2m or even wider spacing pattern can be practiced. This final decision depends upon the locality and the expected sale value of various agricultural crops and the tree component.

REFERENCES


